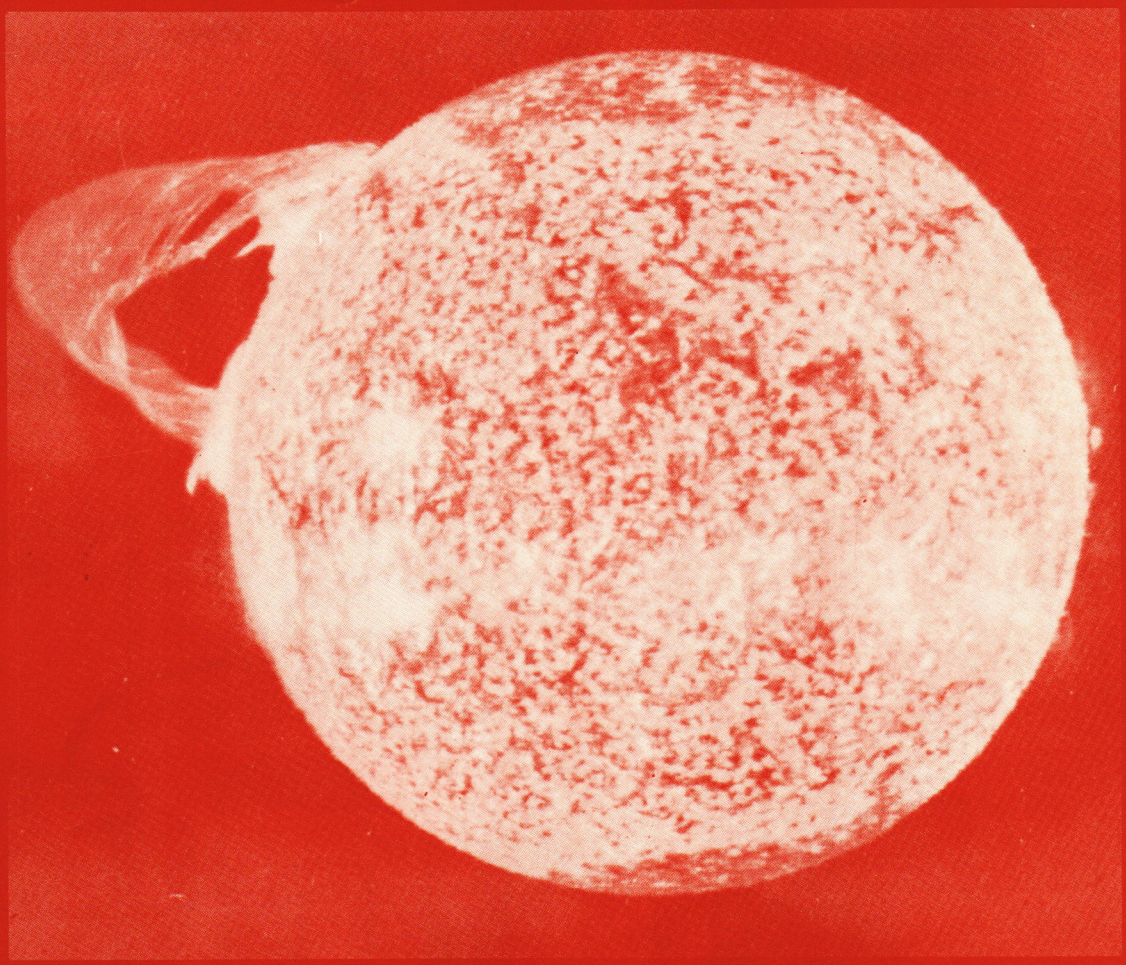
VOLUME 34, NO.2 • THE GEORGE WASHINGTON UNIVERSITY • EDITION 2, SUMMER 1987

MECHELECIV



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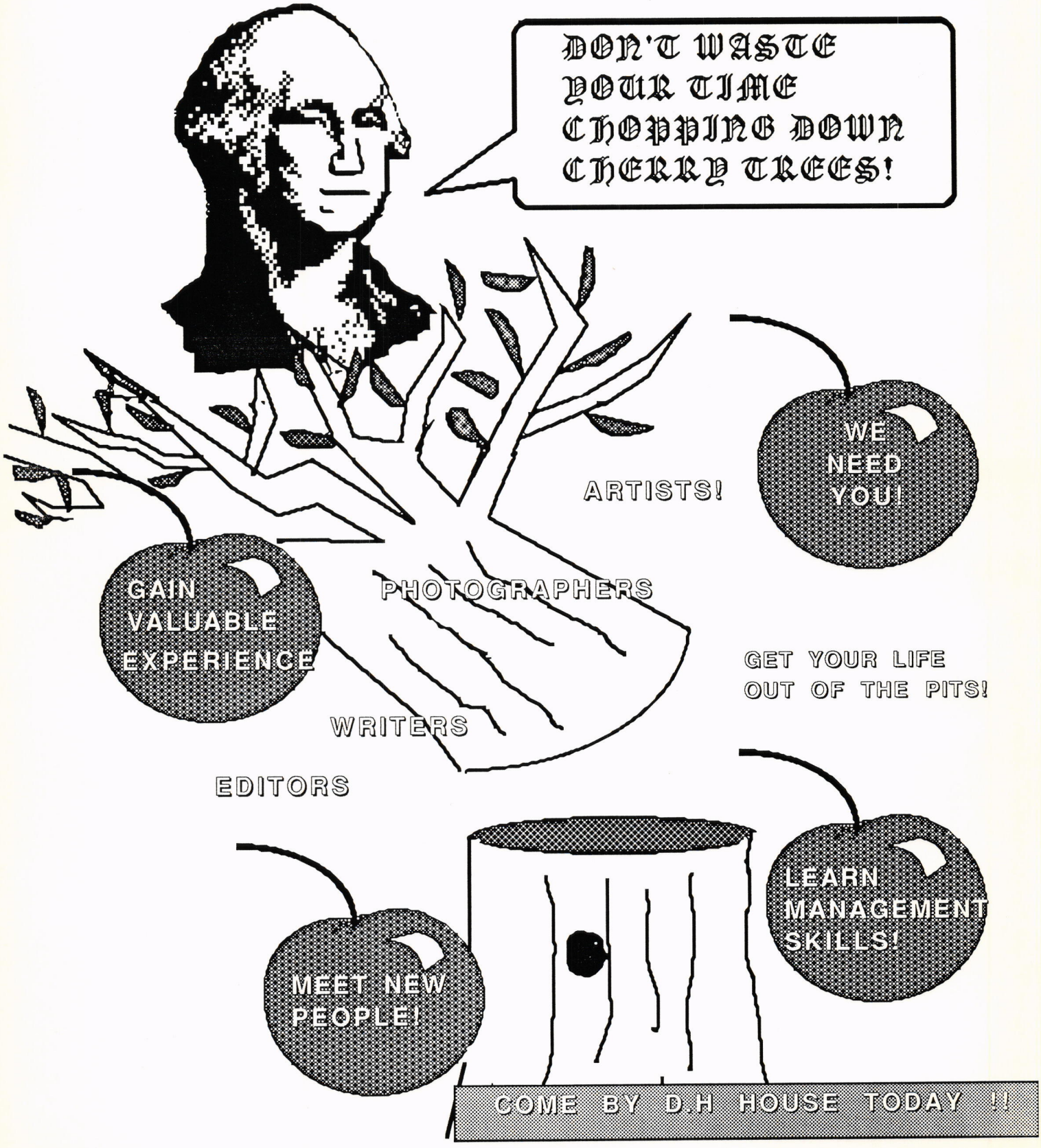

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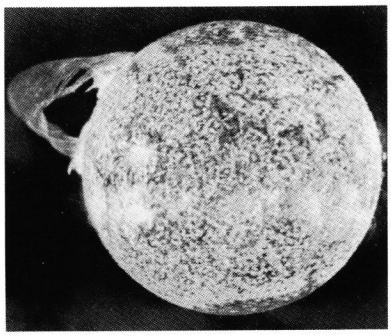
MECHELECIV

Established 1942



COVER: Coronal disturbances give a picturesque image of our friendly neighborhood Sun.

VALVES MAINTAIN HEATING AND COOLING PROCESSES

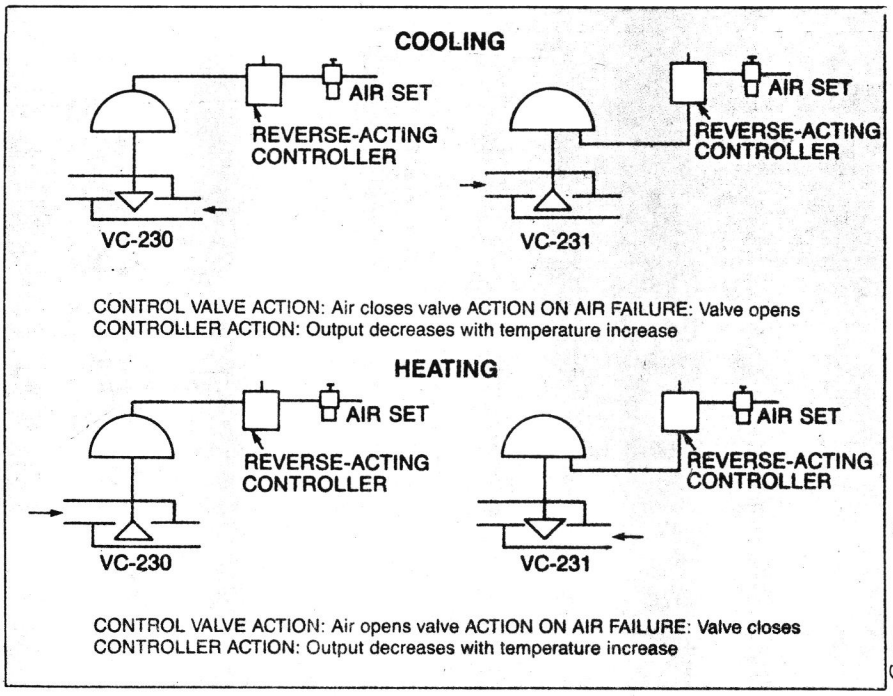
What happens when a processing industrial system overheats or in another extreme, freezes? There must be a way for process heating and cooling to be controlled, but with what? Diaphragm-actuated control valves are recent devices which provide cost effective, durable, long service life regulation of heating and cooling flows. A line of packaged fluid, heat transfer systems, utilize these pneumatically operated, diaphragm-actuated control valves to give precise, sensitive temperature control. The manufacture of paper, plastic products, and chemical rubber are regulated by such temperature-controlling valves.

Aside from being cost-effective and durable, these valves are equipped with current-to-pneumatic converters, thus providing for control by programmable digital computer control equipment. This electro-pneumatic relay functions by converting low voltage, dc signals to standard 3-to 15psi pneumatic signals. This method of electric or pneumatic control speeds response and broadens the scope of the device.

When the valves are controlled by signals provided from either the pneumatic or electronic controller, modulated flow of hot oil, hot water or chilled water is released to the processing system, depending on the heat demands of the processing machinery. These hot water, hot oil, or chilled water flows maintain the temperature of the processing equipment at the level required for optimum quality and production.

The fluid heat transfer systems, designed and manufactured by Budzar Industries, typically apply to equipment used in the mixing of rubber, and in the extruding of plastic and rubber materials. These valve-utilized systems are built in both standard and customized versions. As a result, being engineered to meet specific operating requirements, and being shipped as ready-to-install packages to domestic and international users, these packaged heating and cooling systems provide an extremely effective method of transferring or removing large quantities of heat.

— Swati R. Patel



COURTESY OF DESIGN NEWS

The process of cooling and heating is illustrated above with the use of reverse acting controllers.

The New Baby on the Block

From 12 billion light years away comes the information which may enable astronomers to solve the mystery of how galaxies form. A team of astronomers led by Patrick McCarthy at the University of California, Berkeley, have observed what could quite possibly be a birth of a galaxy. It is located near the constellation Corona Borealis and was sighted mainly from the incredible amounts of radio waves it emited. The object is known as 3C 326.1 in a catalogue of radio sources.

Oddly enough, the amount of light its stars emit is rather low (approximatly equivalent to 100 million suns) compared to the amount of ultraviolet rays its gaseous clouds emit (approximatly equivalent to 10 billion suns). As Berkeley's Hyron Spinrad puts it, "This indicates that 3C 326.1 hasn't processed its gaseous raw material into stars." In other words, it is a galaxy being born.

This nascent galaxy is, however, old enough to have already bred a few stars since heavier elements such as carbon were detected in it. The heavier elements are thought to be formed only by the process of fusion that takes place in the heart of a star.

Since the information took 12 billion years to get here, what the astronomers are seeing actually occurred 12 billion years in the past when the universe was only one quarter of its present age. The barrage of radio waves the new galaxy is sending is only comparable to the barrage sent by the mysterious quasars which, many scientists suspect, have black holes in their centers. Black holes are collapsed stars whose mammoth gravitational pull do not allow even light to escape. If there is a connection, than an intriguing argument could be made in which black holes may act as the seeds from which galaxies are born.

— Vaiji Ramaswami

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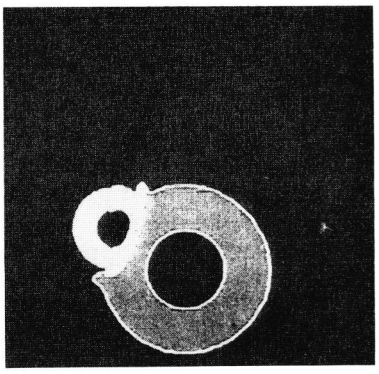
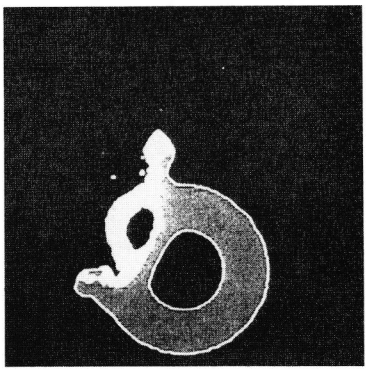
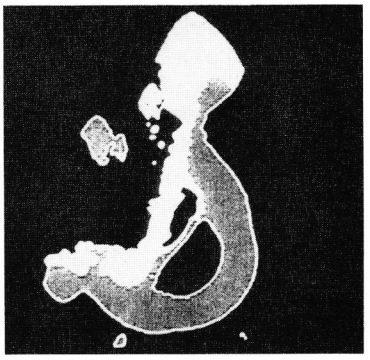
Where Did the Moon Come From?

Four and a half billion years ago after the birth of our solar system, a stray object of Mars-like size makes a head-on collision with Earth, shattering some mantle and spewing material into space. This vision came to life through the simulations of a supercomputer to illustrate the formation of the moon. The theory is called the giant impact theory.

In the 1960s, the Apollo missions to the moon attempted to answer the probing question of how the moon was formed. The three classical theories were capture, fission and double-planet theory. The capture theory stated that the moon, born somewhere else in outer space, was swept into Earth's gravitational field. This means that the moon and Earth's minerals and chemistry are different. The fission theory claims that the moon was a torn-off section of young Earth. If so, their chemistry must be exactly the same. The coformation theory says that Earth and the moon were two close neighbors from the beginning, where eventually, the small moon became the satellite of Earth. Once again, this implies that their chemistry should be similar.







An unsuspecting object of Mars-like size collides with Earth, shattering some mantle and spewing material into space.

COURTESY OF POPULAR SCIENCE

Instead of verifying one of the classical theories, the Apollo missions only succeeded in disproving all three. From the abundance of rock and core samples, scientists identified elements found on the moon that were also in the Earth's crust. This discovery nullified the capture theory. Yet, there were also significant differences, such as the scarcity of volatile material, thus ruling out the fission and double-planet theories.

The contradictions of the classical theories only paved the way for the giant impact theory, formulated by William Hartman of Planetary Science Institute in Tucson, Arizona and Alastair Cameron of Harvard-Smithsonian Center for Astrophysics in Cambridge Massachusetts. With the help of the Cray supercomputer in Los Alamos National Laboratory, collision simulations were done between Earth and different-sized objects approaching at different speeds. Finally, one simulation resulted in an immediate formation of the moon. Further verification came from similar simulations in Arizona, thus giving credibility to the giant impact theory.

This theory answers many unresolved questions. First, the moon lacks iron, very much like Earth's mantle. In this simulated explosion, it is Earth's mantle that is separated. Second, the lack of volatile materials on the moon can occur as a result of a big explosion, such as the Earth-object collision. Finally, the theory can explain another phenomenon - large angular momentum of the Earth and the moon. A direct hit at the equator from another object can easily force young Earth to spin so fast. During the early years of our solar system, there must have been many objects about the size of Mars, capable of striking Earth and eventually forming the moon. Although the giant impact theory seems to be the answer, we will never know the real truth, unless we go back in time four and a half billion years after the birth of the solar system.

— Lilimar Z. Avelino

THE "AUTO-K" MEASURES THERMAL CONDUCTIVITY

Need to find out the insulating properties of a specific material, but have little time for tedious, time consuming calculations? Well now, rigorous experimentation and calculations no longer need to be performed, because self-contained instruments automatically calculate the K-value of certain samples.

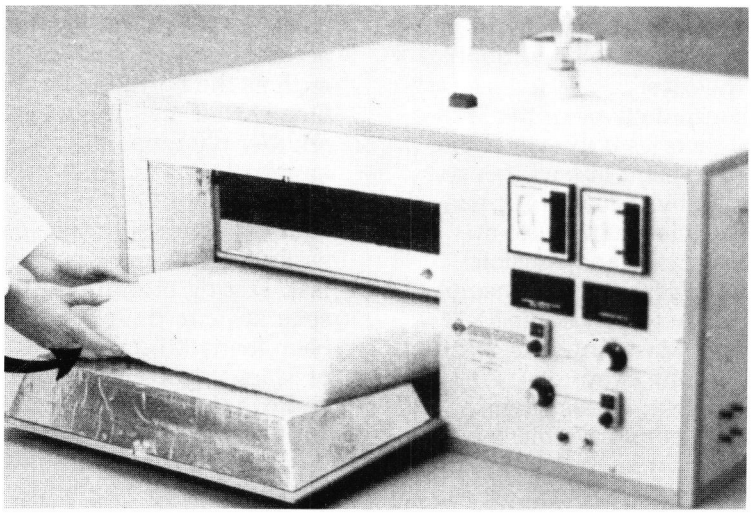
Built by Sparrell Engineering Research Corporation, the device, called, the "Auto-K", measures thermal conductivity. It is a device which utilizes two heat flow meters and consists of two surfaces which sense the sample's heat flux. This, in addition with the temperature difference across the sample and sample thickness, allows for the calculation of the K value, from which the resistance, R, value, may be obtained. Unit thermal resistance of an insulation material, the R value, is the reciprocal of thermal conductivity.

The "Auto-K" incorporates a heat sink and heater assembly. The heat sink is a flat-plate located at the lower portion of the device and is cooled from below by solid state thermoelectric refrigeration modules. This heat sink provides the cooling to the sample in question. The second plate is the mobile heater assembly, which constitutes the top region of the device; constructed opposite that of the heat sink. This heater assembly is warmed by a uniformly-dispersed electric heater; therefore, with the use of both the heat sink and the heater assembly, the sample is sandwiched between the cold and warm plates, respectively.

When setting up, a controller selects a heat sink temperature, and a constant, precise temperature difference between heater and heat sink plates. Since this temperature gradient between the two plates is fixed, the principle of operation states that the thermal conductivity is directly proportional to the sample's heat flux.

To summarize this process: The heat flow meters measure heat flux; that is, the top meter senses how much heat flows into the sample; the bottom senses heat flow out of the sample. Therefore, based on sample thickness, temperature difference across the sample, and output from the two heat flow meters, the devices' analog logic circuit calculates the thermal conductivity of the sample being tested. The results are then displayed digitally. A second digital display also illustrates the meter's hot face, cold face, and average sample temperatures, as was chosen for operation. As seen from the creation of such mechanical wonders, research corporations like Sparrell Engineering, will make our future a lot more automated and a lot less tedious.

— Swati R. Patel



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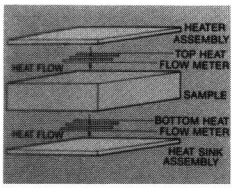

Used to determine insulating properties of winter clothing, this "AUTO-K" uses two heat flow meters, placed on either side of the material being tested.

Induction Heating Invades the Home

Stop for a moment and consider how electromagnetics effects your life. Very nearly every household appliance is powered by electricity, a form of electromagnetic energy. You would not be able to read this very sentence if it were not for your eyes' detection of the visible spectrum of electromagnetic waves: light. The remarkable possibilities for electromagnets is limited only by the imagination.

Most of us have used a microwave oven before. You just put some leftovers in it, turn it on for a couple of minutes, and voila: dinner. The food is hot, but the oven is not. Wouldn't it be great to have this capability on the stove too? Well, using the principles of electromagnetics, with which we are all so familiar, there is a way to do this. It is called induction heating.

Induction heating is a little bit different from microwave heating. Instead of heating the food directly, a metal pan on the stove is heated through induction, which

in turn cooks food. The beauty is that no heating element is required. Recently, there was an advertisement for a General Electric induction heating stove. I thought, "This must be the cutting edge of technology." In fact, this technology has been used by industry since the 1930s. It has been used with such things as soldering or brazing, where the heat is confined to the area being treated.

How does it work?

To get an idea of what is happening, consider a hamburger in a pan on the General Electric portable induction heating stove. There are a number of coils under the surface of the stove on fairly large time varying current; which in turn, will produce a time-varying magnetic field and a magnetic flux. To translate this into heat, we first use Faraday's law of induction: emf = -dI/dt, where the time-varying quantities emf and I stand for the electromotive force and the flux density, respectively. What this says then, is that when we have a time-varying magnetic field, an emf or voltage will be produced.

Now, in a closed circuit where there is voltage there is current. In this case, there is a pan sitting on top of a number of current carrying coils which produce a magnetic field, which in turn produces a voltage in the pan. The pan then is the complete circuit, and eddy currents will be produced in the pan. (If you have a "direct drive" turntable at home, it works on the same principle.)

Thus, if the current in the coils is sufficiently large, it will induce significant currents in the pan. The pan will act like a resistor in a circuit. It will dissipate energy in the form of heat, which then cooks the hamburger. This is the same heat which is minimized as much as possible in the design of transformers.

The amount of heat produced depends on several factors, such as the type of material, the size, the mass, and the specific heat of the pan, as well as the length of time on the stove. I will not repeat the equations which describe this phenomenon. It is sufficient to say that these equations can become fairly complex in their complete form. Please remember, though, the next time you are near an induction heating stove: take off your watch, remove your belt buckle, and take off your neckless.

— Louis R. du Treil

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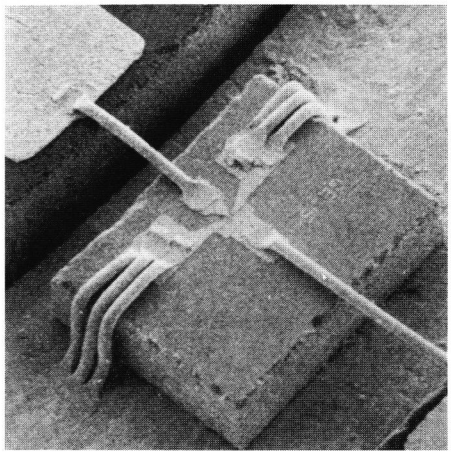
WORLD'S FASTEST TRANSISTOR?

COURTESY OF DESIGN NEWS



This device contains gates approximately 59 microns smaller than a human hair, yet is now known to be the world's fastest transistor . . . Believe it? Well, GE and Univ.of Illinois are convinced.

The transistor, discovered in 1947, is a miniature, electronic, amplifying device that performs all the functions of the electronic vacuum tube. The original transistor was first made of germanium. There are others which also utilize silicon, aluminum, gallium, and arsenide. As advancements have been made in the area of electronics, transistors have begun to transmit current at faster rates.

Just recently, two great scientific research institutions collaborated to demonstrate what they claim to be the world's fastest transistor. In a cooperative venture, General Electric Electronics Laboratory conducted the device's design, fabrication, and testing, while the University of Illinois Coordinated Science Laboratory provided the materials for the experiment.

When tested by GE, this new transistor illustrated remarkable characteristics, many of which are the following:

—The speed of operation is the highest for any transistor yet reported, as claimed by Alan Swanson, manager of advanced materials and devices at the GE lab. This fast device operates at 60 GHz, which is better in terms of low noise performance and power performance than any other transistor.

—The GE - Illinois transistor showed a 230 GHz projected cutoff frequency (maximum frequency at which the transistor can operate). This 230 GHz is also the highest yet reported for a three-terminal transistor.

—Its low noise performance indicates that it is a device capable of detecting extremely weak signals, thus proving to be of great use in military, space, and civilian communications endeavors.

—The device consists of a gate embedded in a layered structure made of both aluminum gallium arsenide and indium gallium arsenide; therefore, it is known as an AlGaAs/InGaAs Pseudomorphic MODFET. The InGaAs channel layer, however, is the essential key for the device's record speed. This layer possesses a higher electron mobility than GaAs or AlGaAs for faster electron flow.

—The device contains a gate only 0.25 microns long, thus occupying very little space on a circuit board.

With such fascinating characteristics, it's no wonder this

Continued on page 14

SUN WORSHIP - ARE WE WORSHIPING A FALSE GOD?

by Rose Province

THE sand is warm under your feet, an ocean breeze is blowing, the rays of the sun are giving your body a dark tropical tan . . . . . ahhh heaven. Or is it?

Underneath that beautiful golden tan, the sun is reeking havoc in your epidermal and dermal cells, in other words your skin. The sun produces two kinds of ultraviolet rays , A radiation (UVA), and B radiation (UVB), both of which can tan, permanantly disfigure, and even kill. UVA radiation has longer wavelengths than UVB. It has been shown that a high concentration of UVA, and a low concentration of UVB gives a faster darker tan. This method is employed by tanning saloons, many of who claim that thier tan is safer than a natural tan. But this claim is now being questioned. Recently UVA was shown to cause mutations in the cells of laboratory animals.

There are three major types of skin cancers that victimize innocent sun loving Americans. The most common form of skin cancer is BASEL CELL CARCINOMA, which 400,000 Americans get each year. This cancer is gotten primarily as a result of overexposure to the suns ultraviolet rays. This cancer is non lethal and shows up mainly on the nose or around the eyes.

The second type is SQUAMOUS CELL CARCINOMA, which affects 100,000 Americans each year. This cancer developes anywhere on the face and the body, and grows farther and faster than basal cell carcinoma, it also requires more extensive surgery.

The last type is MALIGNANT MELANOMA, which is rapidly spreading cancer that kills 1/4 of its victims. This is the least common cancer though affecting only 25,000 Americans a year. The worst news is that the reported cases of all types of skin cancer, is increasing each year and is expected to have a four fold increase by the year 2000. There are a number of factors that could be contributing to this, the increased number of retirement age Americans, the popularity of the "deep tropical tan" look, and finally the decreasing level of the ozone layer due to chemicals released in massive amounts into the earth's atmosphere.

Most frightening of all is the last contribution mentioned, the depletion of the ozone layer. So what is our government doing about this? A tentative agreement was made to freeze production of chlorofluorocarbons(CFC's) at current levels and reduce there use by 20% over the next decade.

The efforts to impose greater controlls on CFC's were strengthened by the "greater than expected" global drop in ozone levels, and the discovery of a mysterious "hole" that appears each hear in the ozone over Antarctica.

The cause of the hole has not been conclusively determined, but a research team said the best evidence points to CFC's. But the administration is reconsidering it's

strong call for international controls on flourocarbons, and is introducing a proposal for a public relations campaign to encourage the use of sunglasses and skin lotion, in place of the CFC ban. The interior secretary Donald Hodel, is argueing for this alternative program of "personal protection" against ultraviolet radiation. A major flaw in this plan is that it will be awfully difficult to get plants and animals to wear sunscreen.

Even so, with or without CFC in the air, sun screen and sun glasses are a good idea for all us humans. UV rays that penetrate into the underlying dermis, the living,growing layer of the skin, can kill many cells and disrupt cellular structure and growth patterns in others. These disruptions occur whenever skin is exposed to sunlight, and have cumulative effect. The skin can recover from a certain amount of damage, but repeated exposures can cause severe wrinkling, skin cancer, and a number of other symptoms.

The best defense against this damage some authorities say, is wearing sunscreen on a day to day basis, not just when spending the day at the beach. One should also have a full understanding of what the tanning process is.

First of all, everyone is born with a certain amount of "tan". Black people have the largest amount of pigmentation or melanin in their epidermis, and so rarely have trouble with sun damage. Melanin acts as a filter to absorb and block out the suns ultraviolet light. Albino skin types are on the other end of the spectrum, with virtually no pigmentation in there skin, so they of course suffer from a variety of disorders caused by sunlight. In tanning the melanin already present in the skin is activated, and more is produced. So sun exposure that is gradually increased is much safer than a quick attempt at tanning darkly, which usually results in a bad sunburn, and skin damage.

Now that the sun has been made out to be the enemy, something that should be stayed away from, lets take a look at the other side of the coin. The sun produces vitamin D in the skin, a neccessary ingrediant to your good health. Also, not only does the sun make you look good, it makes you feel good too. As proof of this, when spring approaches, signifying the sun is closer and with us longer, our energy level increases, we need less sleep, we concentrate better, and are happier people in general, Not recieving enough sunlight can depress you, weaken your libido, and even cause you to gain weight. People who have extreme physiological symtoms caused by the lack of sunlight suffer from Seasonal Effective Disorder(SAD). So do not stay away from the sun, after all where would this planet be without it? Becoming educated about it will enable us to have long healthy lives, full of sunshine.

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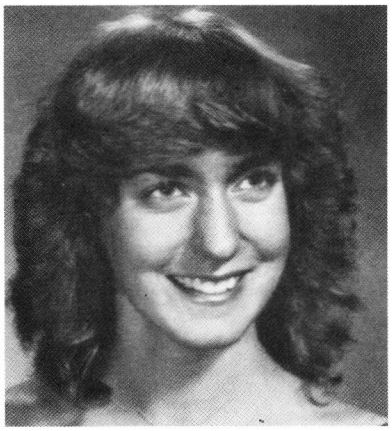


Rose Province, majoring in EE-premed, is currently a co-op student at NASA in Greenbelt,MD. She serves as co-editor for MECHELECIV, is a member of Tau Beta Pi engineering honor society and vice president of Eta Kappy Nu.

COMMON PHOTOSENSITIZERS

USE	SUBSTANCE
tranquilizers and antihistimines	phenothiazines
antihypertensives and diuretics	chlorthiazides
hypoglycemic or antidiabetic drugs	tolbutamide chlorpropamide
antibiotics and antibacterials	tetracyclines sulfonamides
antifungal agents	griseofulvin
oral contraceptives	mestranol norethindrone diethylstilbesterol
artificial sweeteners	saccharin cyclamates
sunscreens	PABA and PABA esters
deoderant soaps	hexachlorophene halogenated salicylanides
cosmetics	plant oils (bergamot,lavender, citron,lime,sandalwood,cedar) dyes (eosin,fluorescein,methylene blue)
shampoos	coal tar derivatives

Many common chemicals found in everyday household and cosmetic products, cause increased sensitivity to sunlight. These chemicals are called photosensitizers.

CHERNOBYL - A NIGHTMARE NEVER TO BE FORGOTTEN

by Vaiji Ramaswami

IN the early hours of April 26,1986, an explosion rocked the countryside of Chernobyl, the impact of which would be remembered for years to come. The explosion was the result of an experiment gone awry at the Chernobyl nuclear power plant in the U.S.S.R. The blast was powerful enough to blow away the thousand-ton lid of the reactor's core as well as rip off the ceiling and the side of the building. The Chernobyl nightmare has been the worst accident since nuclear plants came into existence.

An around the clock effort began to contain the disaster. Helicopters flew over the exposed reactor and dropped sacs of lead (to seal and shield the vault), boron carbide (to absorb neutrons), sand and clay (to cutoff oxygen and filter radionucleides). Meanwhile, the uncovered reactor spewed out several tons of uranium dioxide fuel and burning graphite, as well as fission products, such as Cesium 137 and Iodine 131. As the Soviets reported it, 50 megacuries of the most dangerous radionucleides as well as 50 megacuries of chemically inert radioactive gases were released into the atmosphere.

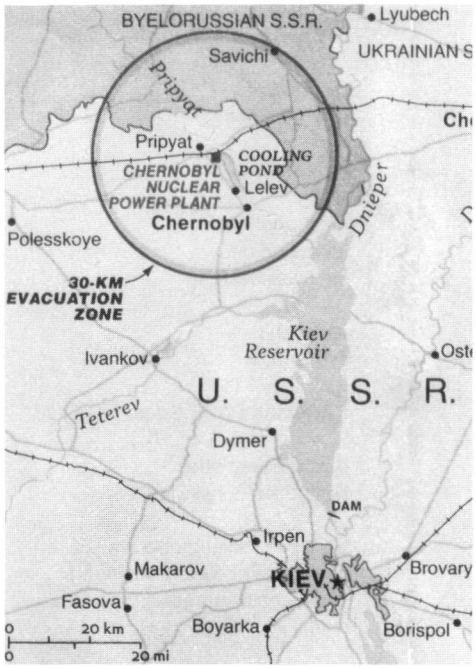
The final objective, after the exposed reactor was contained, was to entomb the reactor building and parts of the adjoining turbine hall in walls of concrete and steel. Over 45,000 people from the neighboring city of Pripyat and another 116,000 people from the Ukraine and Byelorussia were evacuated and resettled outside a 30 kilometer radius from Chernobyl. Soldiers, firemen and workers worked side by side to keep the pollutants from contaminating the Pripyat river which feeds into the Dneiper, the water source for the city of Kiev, 130 kilometers to the south.

The death toll is at 31 at this time. Scientists estimate that another 100 to 200 of those evacuated will die of cancer, while another 22,000 to 23,000 will become seriously ill from the radiation. Outside of the 30 Km zone, many experts predict that a death rate of 5,000 to 75,000 from the radiation will occur in the coming years. An example of the radiation doses received is found in the city of Lelev 9 km from the plant. There the radiation measured in the thyroid of the children was as high as 250 rem, as a result of ingesting iodine 131 from the milk they drank. In general, 25 rem is the maximum safe, once-in-a-lifetime dose any person can receive.

Many of the 31 persons killed were firemen who came to extinguish the fires caused by the burning graphite. "All of them clearly realized what was in store", said one of the fire chiefs. Most of those killed, died from fatal doses of radiation. Among the others who died were paramedics and construction workers.

The plant at Chernobyl was one of the most powerful nuclear

COURTESY OF NATIONAL GEOGRAPHIC



Outside of the 30 kilometer evacuation zone, a death rate of 5,000 to 75,000 is predicted due to the effect of radiation.

EULER UY

Vaiji Ramaswami is a senior EE-CS major at GW, and TECH BRIEFS editor of MECHELECIV. After receiving her B.S. degree, she plans to continue on to grad school and earn a Masters Degree in Computer Science. She would then like to return to India, in order to work in her profession.

power stations in the Soviet Union. At full power, the RBMK - 1000 reactor would have supplied enough power to yield a thousand megawatts of electricity. This is equivalent to the amount of power necessary to light up all of Toledo, Ohio. The main drawback of this reactor is that it must be operated at almost full power. At low power, the reactor becomes extremely unstable.

At around 1:00 AM on that fateful day, operators at the plant began an unsupervised and unapproved test of the generator. They turned the emergency systems off, including the safety valves which would have shut the reactor down if it went out of control. Within a few minutes, the power surged to 100 times the operating maximum. This is equivalent to the force of a ton of TNT. The fuel rods were shattered and the heat from the fuel caused an incredible amount of steam, resulting in the mammoth explosion.

Because of Chernobyl, the safety of RBMK reactors have become the subject of a heated debate. Many claim the RBMKs are safe but they require a stronger shielding around the reactor. In the words of one critic, " What [the Soviets] had was a tin can." Others argue that the reactor was well designed and nothing could have contained the blast.

The Soviets have taken the monstrous accident quite to heart. They have declared that no other plant will be built after the completion of the seven that were already under construction. They have increased the discipline of their operators, as well as retrained many of them. They have also made several changes in the RBMKs themselves.

To help them contain the disaster, the Soviets received valuable aid from many western experts, especially Dr. Gale and Dr. Armand Hammer. Upon hearing about the disaster, Dr. Gale who heads the International Bone Marrow Transplant Registry and the transplant team at the School of Medicine of the University of California, immediately offered his services. Bone marrow which produces red blood cells is seriously damaged by gamma radiation and must be transplanted. Dr. Armand Hammer, the multi-millionaire, sent a letter to Mikhail Gorbachev offering to bear all costs of the transplants.

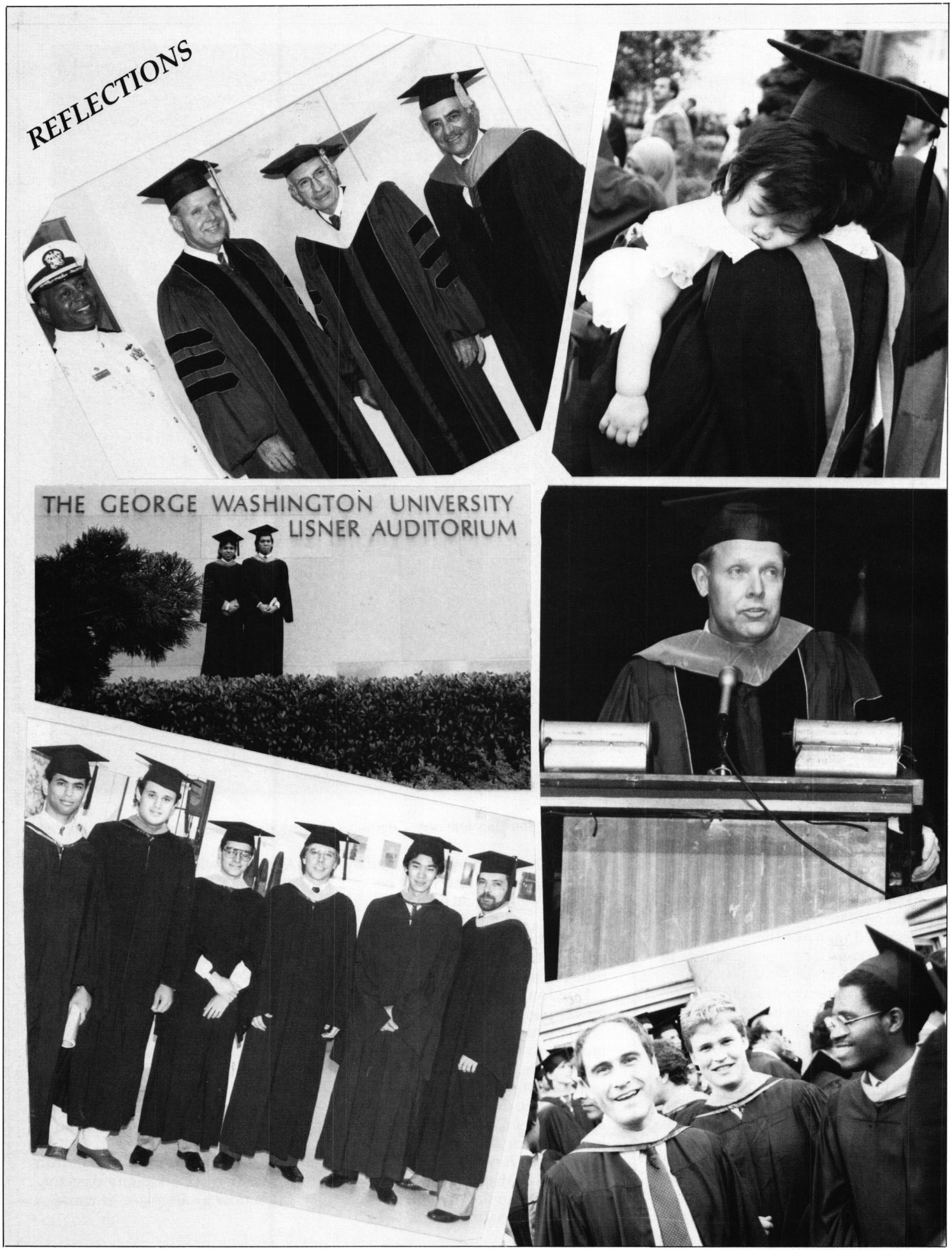
COURTESY OF NATIONAL GEOGRAPHIC

A helicopter flies low over Chernobyl, testing the radiation from the ruins of the reactor.

Due to the efforts of many, the power plant is now under control. The reactor has walls of concrete more than a meter thick around a steel frame. It contains various instruments to measure radiation and seismic devices to detect any sinking or shifting. Dr. Legasov, a leading nuclear scientist, says the radiation is now " one hundred times lower than permissible values". A similar statement was said by Dr. Morris Rosen, the American who is the IAEA's safety director, " It is now a safe place to work".

Although, Chernobyl was a frightening and costly incident, it could yield a vast amount of valuable information. Before, theories could only be based upon guesses on the effects of a cataclysmic nuclear mishap. Now, physicists have actual observable data. Also, the relationship between radiation and cancer may become much clearer by studying those who were exposed to the radiation.

Dr. Morris Rosen, the American who is the IAEA's safety director, " It is now a safe place to work".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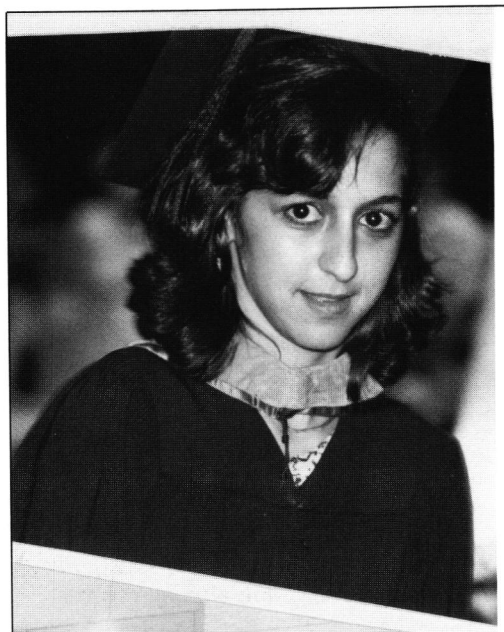
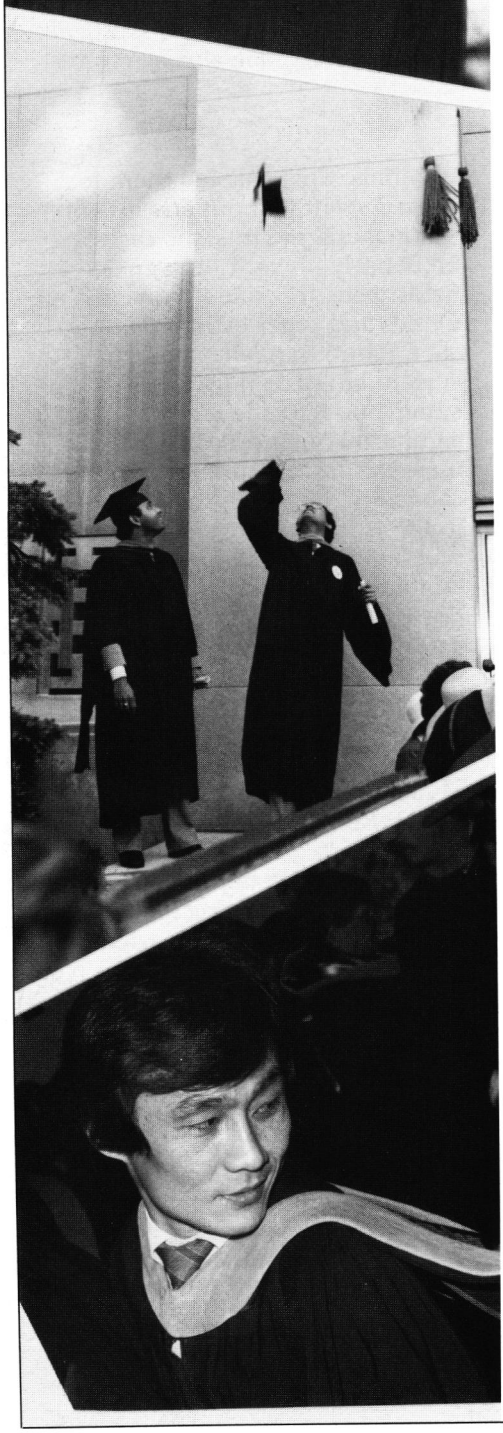




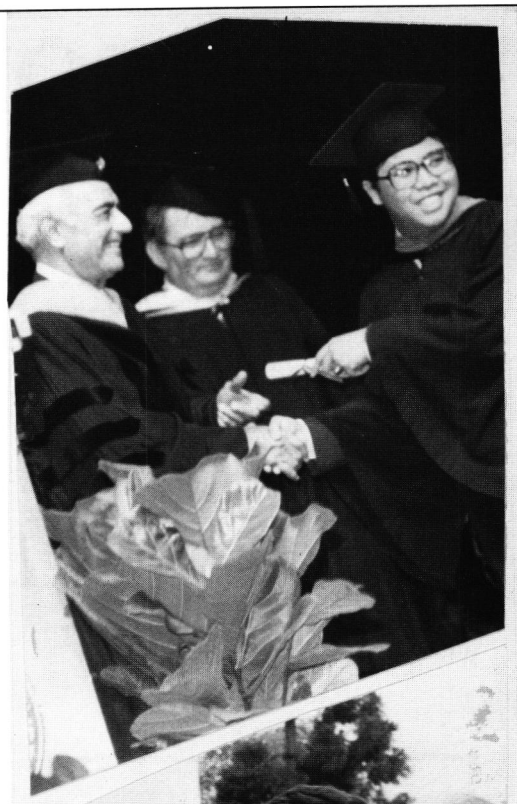
FAREWELL TO THE CLASS OF '87

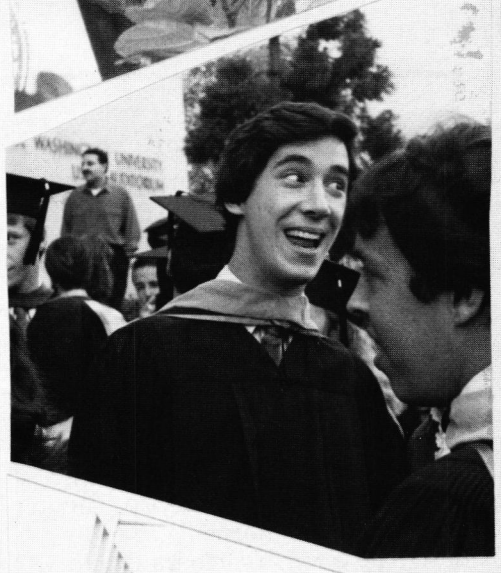
The George Washington University held its one hundred sixty-sixth Annual Commencement on Sunday, May 10, 1987. Each one of the six divisions of GWU conducted its own commencement for the School of Engineering and Applied Science. President of the University Lloyd H. Elliott conferred the degrees on the graduating engineering students and an honorary degree for Mr. Richard H. Peterson, director of the National Aeronautics and Space Administration-Langley Research Center. Mr. Peterson also delivered the commencement address. Associate Dean James E. Feir presented the Norman B. Ames Award to Mr. Daniel L. Briller for his services to the GWU's engineering community as editor-in-chief of MECHELECIV. Dean Harold Liebowitz presented the School of Engineering and Applied Science Award to Captain Gordon E. Fisher of the United States Navy. The department chairmen of EE/CS, CMEE, OR, and EAD introduced the candidates for Bachelor's, Master's, and Professional Degrees in their respective departments. To top off this special day, a subsequent reception at the Marvin Center's Continental Room provided the graduates and their families and friends with refreshments and farewells.

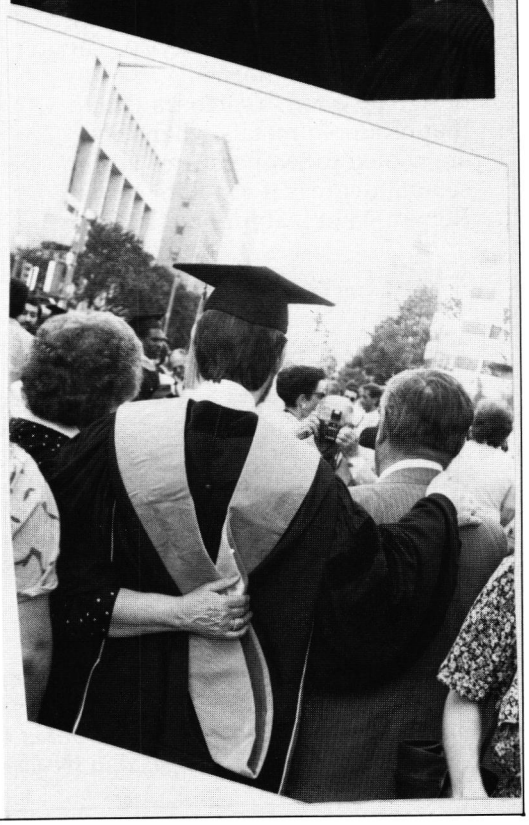
— Ka P. Lee

Special thanks to Margaret Hansen for providing our photographer special access to take graduation pictures.

Photographs by Euler Uy







SUPERCONDUCTORS . . .

IMAGINE a train floating on a cushion of magnetic force; supercomputers several times faster and more powerful than today's biggest computers, but much smaller and cheaper; ships, subways, and refrigerators powered by electric motors with one-half the size, one-half the weight and one-half the current compared to those used today. Imagine building devices that read signals in brain cells, produce more powerful atom smashers, bring about fusion reactors that generate power from inexhaustible fuels

by Kavita Patel and Claire Silvestre

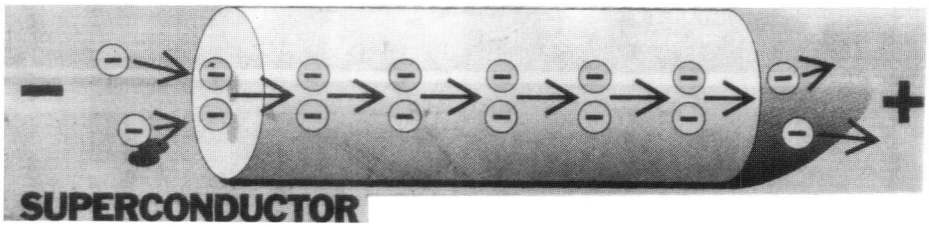
and create practical electric cars. These are the startling possibilities now made available to the modern world by an unusual occurrence, known as superconductivity. The phenomenon is normally used to designate a remarkable transition that occurs in metals when they are cooled to temperatures within several degrees if absolute zero (0 Kelvin, -460 F), an impractical temperature representing a total absence of heat. However, due to a recent breakthrough in the field, superconducting substances can be made to lose all electrical resistance at manageable and more economically feasible temperatures.

From the time the Dutch physicist Kamerlingh Onnes discovered superconductivity in 1911 until the recent breakthroughs, there was only one way to achieve this phenomenon. The method involved immersing the appropriate metals in a bath of liquid helium at a near absolute zero temperature of 4.2K (-452F). At a low temperature such as this, molecular motion was greatly reduced. Thus, electrical current experienced no resistance to flow within the superconducting materials. This enabled them to carry current without any loss of thermal energy. In some cases, immensely powerful magnetic fields were generated; however, Onnes and other experimenters soon found that once enough current began to flow through the superconductors to create significant magnetic fields, the materials lost its superconducting capability. Not until the discovery in the 1950's of alloys, such as niobium tin and niobium tantalum, was there a solution to this problem. Nevertheless, the process was still highly impractical, expensive, and energy consuming.

No real progress was made until January 1983 when Karl Alex Muller, a physicist at the IBM Zurich Research Laboratory in Switzerland, was able to raise the superconducting temperature to 30K. Instead of utilizing the type of metallic alloys previously used, he decided to work with what are known as half-metal ceramics or metallic oxides. These layers consisted of elements such as lanthanum, barium, copper, and oxygen. In extreme cold, this formula appears to allow the atoms to bond more closely, thus providing an easier path for electrical current to flow.

On January 29, a startling revelation was made by Paul C.W. Chu from the University of Houston, that revolutionized the world. Chu announced that he

COURTESY OF TIME MAGAZINE



In a superconductor, electrons lock together forming pairs which move in step with one another. Collisions are avoided and resistance disappears, thus eliminating loss of thermal energy.

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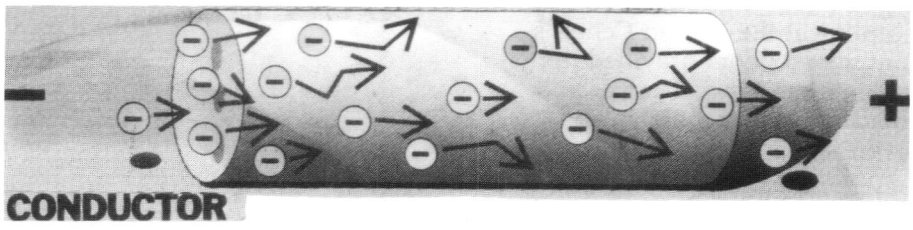
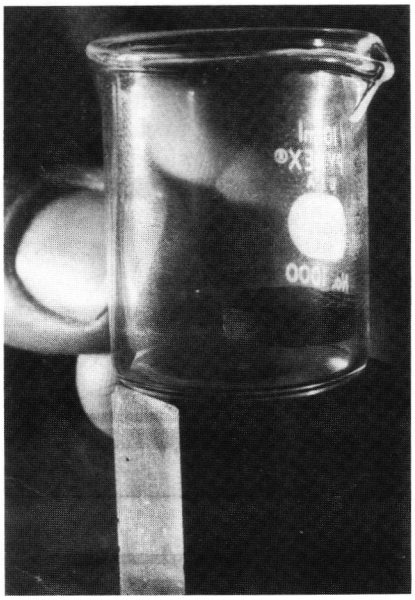


When an electric current - a stream of loosely bonded electrons - flows through a conducting material, resistance is encountered. The electrons collide with one another and with small impurities within the lattice-like architecture of the metal. As a result, energy is dissipated in the form of heat.

TOMORROW'S TECHNOLOGY



Intense magnetic fields generated by the superconducting ceramic pellet helped to deviate it over a magnet.

had raised the maximum superconductivity temperature to 95K(-288F), the highest ever reported. He achieved this first by replacing barium with strontium having a smaller atomic structure. This helped to compress the molecules within the substance, thus bringing the layers of elements closer together. Then, by replacing lanthanum with another rare-earth metal, yttrium he brought the layers still closer. Futhermore, this new discovery permitted liquid nitrogen to substitute liquid helium as the coolant. Liquid nitrogen condenses at 77K (-321F) and is less volatile, more plentiful and most importantly, a much cheaper source than liquid helium. The new coolant is less expensive by the quart than milk as compared to a rate of $3 to $7 per liter for liquid helium.

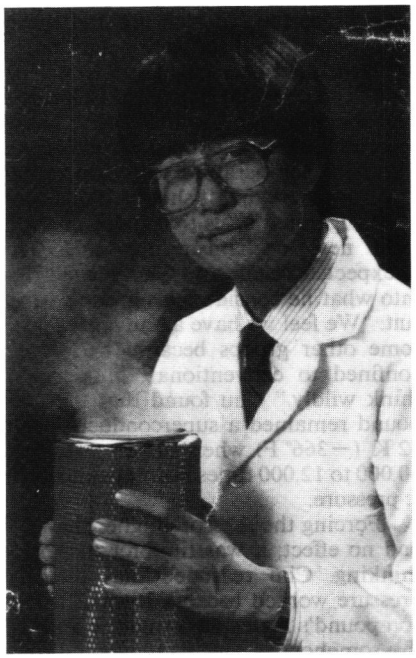
Despite the fact that Chu's new discovery has made superconductivity more practical, there are still two major obstacles to be solved before it can achieve wide use. The first problem is that the new ceramic materials are too brittle to be molded into flexible wire wound into effective coils. Secondly, these substances are not capable of carrying the high electrical currents required for generating strong magnetic fields. Conventional electric wires transport 100 times more currents than superconducting oxides.

Perhaps the most puzzling question facing scientists today is how superconductivity actually works. The conventional theory,known as BCS (Bardeen-Cooper-Schrieffer), states that as electric current (the flow of electrons) moves through an ordinary conducting material, some of the electrons collide with other electrons resulting in the loss of energy in the form of heat. The BCS theory claims that in superconductivity, electron collisions are avoided. In this situation, these negatively charged particles travel through the substances in pairs, known as Cooper pairs. This then enables the particles to flow unhindered through the superconductor; i.e., no resistance, no energy loss. However,if like charges are suppose to be repulsed by one another, then how can two electrons travel together as a pair? Unfortunately, there is yet no definite explanation given to resolve this dilemma.

Regardless of these theoretical and technical obstacles seeming to stand in the way of further progress, scientists have not overlooked the enormous practical applications this phenomenon could yield. Perhaps the first to benefit is the computer industry. Today, supercomputers consists of transistors and other components that are so tightly packed on a chip that they can damage the material due to heat build up from the electrical resistance. Therefore, elaborate cooling systems have been designed to keep the computers from overheating. If these components can be made heat-free and resistance-free, future computers will be much smaller,cheaper, and faster than the one's presently used.

In other applications, the use of superconductors in the transmission of electricity could save consumers billions of dollars. At present, copper is used in power lines, because it carries current more economically than any other conductor. However, in the process nearly 15% of the electricity is lost in the form of heat in order to overcome the resistance of the metal. If copper could be replaced by superconducting wires, power could be transmitted over greater distances with no loss of energy.

More intriguing possibilities exist in the area of transportation. Already, the harnessing of huge magnetic fields formed by these new superconductors have proven to create "flying trains." Trains actually floating on magnetic field about six to twelve inches above their rails traveling at a speed of 300 mph or more. Future cars



COURTESY OF TIME MAGAZINE

Chu holds a flask of liquid nitrogen.

could some day be made efficient enough to propel a standard-sized auto at near highway speeds for miles. The electric motor would still remain small enough to fit under the hood.

The incorporation of superconductors in the production of electricity through nuclear fusion is presently of major interest to experimenters. Since fusion virtually provides inexhaustible quantities of energy, it is a much safer access than fission in nuclear power plants. The major challenge is to create electron-magnetic coils powerful enough so the whole system can remain efficient during intense fusion reactions.

All of these implications are fascinating, yet the most far-reaching notions might not still be conceived. With progress continuing at this rapid pace, room-temperature superconductivity could some day be achieved. As a result, this futuristic technology may no longer be a possibility but an even more practical part of everyday life.

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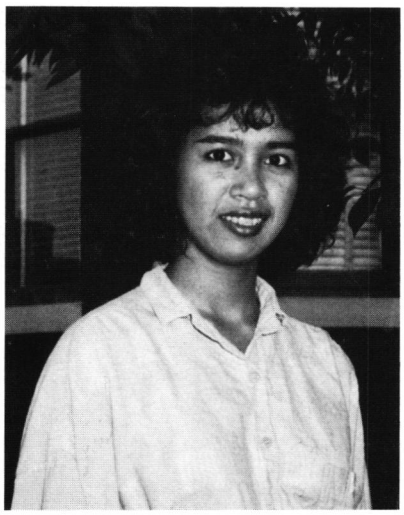
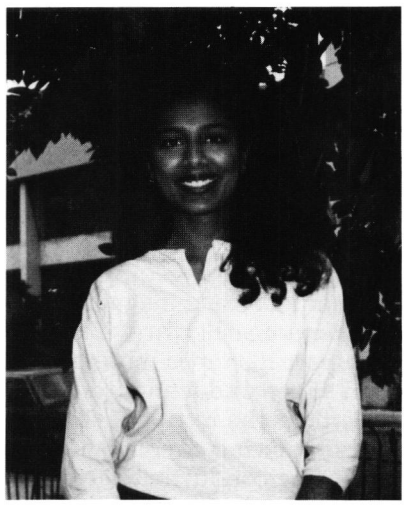


Claire Silvestre, a senior at GW, is MECHELECIV's dedicated layout editor. As a summer hire, she works at Naval Research Lab to gain experience in her field of Electrical Engineering.



Kavita Patel, as a junior EE-premed major, is exploring her options for continuing her education as a graduate law or medical student. In addition to giving invaluable assistance to MECHELECIV by acting as advertising manager, she is also a member of the Pre-Med Society. She is currently working as a computer operator for the Academic Computer Services.

Continued from page 5

device transmits at such record speed and performs above all transistors yet reported. As Professor Hadis Morkoc, project leader at the University of Illinois Coordinated Science Laboratory, states, "This advanced device could help shape a new era in supercomputers, communications, real-time signal processing, and space exploration."

— *Swati R. Patel*

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EULER UY

The MECHELECIV staff diligently works on the layout of this issue. Come join us with your artistic and imaginative talents in the next issue's layout.

RESEARCH SHEDS NEW LIGHT ON THE SUN

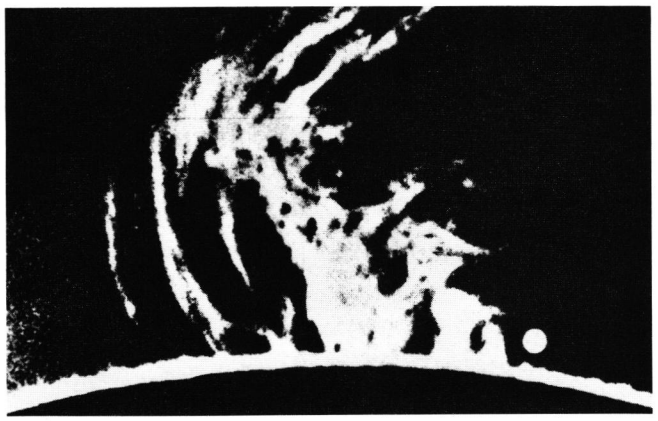
by Lilimar Z. Avelino

Sunny, yesterday my life was filled with rain.
Sunny, you smiled at me and really eased the pain.
Oh, the dark days are done and the bright days are here,
My sunny one shines so sincere.

THE words of the 1960's music, "Sunny", by Bobby Hebb exemplifies the daily significance of Earth's morning light, but what is really happening on the scorching surfaces of our nearest neighbor star, the Sun? However harmless the Sun may look to everyone from afar, it has shown signs of violence, force and power. With telescopes and sophisticated instruments mounted on space-based platforms, scientists have uncovered some secrets of nature's morning light.

Many Faces of the Sun

The Sun consists of three parts: the protosphere, chromosphere and corona. The protosphere, or visible surface of the Sun, radiates most of the energy. Granules cover the surfaces of the Sun. The inner atmosphere or chromosphere reveals the greatest activity. The most apparent natural phenomena are spicules or geyser-like jets of hot gas. The brilliant, blazing corona produces a flow of electrically-charged particles that appear to Earth as the solar wind. The spicules and granules seem to energize the corona. Nuclear processes in the sun produce a conversion of hydrogen to helium. Eventually, that energy is radiated over interplanetary space.



NASA

The brilliant, blazing corona produces a flow of electrically-charged particles.

Another important characteristic of the Sun is the rotating magnetic field that generates energy in the Sun's core. Apparently, the magnetic field holds the key to explanations of solar flares, sunspots, radio and X-ray emissions and cosmic rays. Solar flares, in particular, disrupt radio communication. Sunspots are dependent on this field, because where the magnetic field is most intense, sunspots are larger. Cosmic rays of interstellar space are atomic particles from explosions of massive stars. They possess much energy, but the secret of their energy is altered by our Sun's magnetic field; therefore, data must be recorded before the field scrambles important cosmic messages.

The US Challenges the Sun

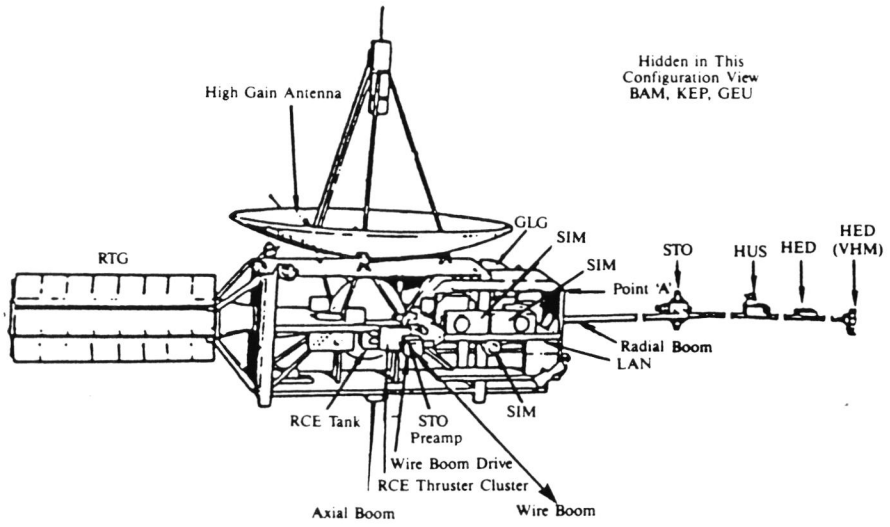
The United States receives much data about the Sun from Solar Max, a spacecraft already in our midst, dedicated to studying solar activity. During eclipses, the protosphere is hidden, making the chromosphere and corona stand out for good observations. In this case, Solar Max can simulate an artificial eclipse using a telescope with an opaque shield, and thus, examine any activities of the Sun.

The National Aeronautics Space Agency (NASA) is planning future endeavors to further analyze, learn and understand the Sun. In a few years, the spacecraft Ulysses will encounter the challenges of space. Traveling around Jupiter, Ulysses will be flung towards the Sun by our biggest planet's gravitational field. This mission aims to intercept those deceptive cosmic rays, and especially study the phenomena at the Sun's poles. By studying polar environment, scientists can gain a clearer idea of how particles travel away from our solar companion. This six and a half or more year journey should uncover and solve many mysteries concerning the sun.

In addition to Ulysses, JPL or the Jet Propulsion Laboratory is building a spacecraft named Starprobe to take samples over the Sun's atmosphere at a distance fifteen times closer than our instruments today. This project is scheduled to be launched in the late 1990s.

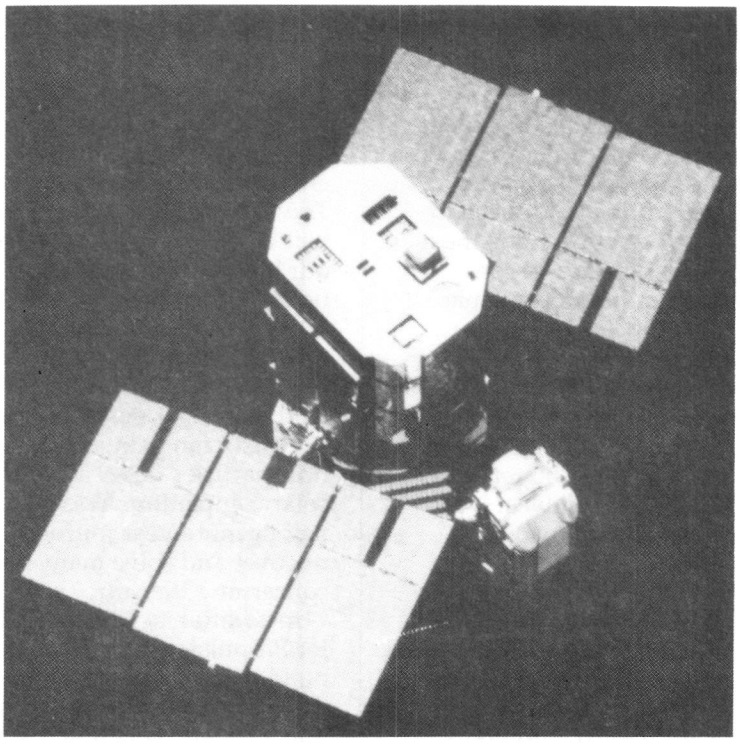
One of the major concerns facing our scientists today is whether the Sun is dimming and shrinking. In actuality, shifts in its nuclear processes and rotations of the magnetic field have caused some dimming. The magnetic poles of the Sun rotate 180 degrees every twenty-two years, and seem to be related to the occasional dimming. It is important to note that any lessening of the Sun's steady heat output in conjunction with a change in Earth's rotation or tilt of axis can easily plunge the world into another Ice Age. Also, measurements of solar diameter indicate that the sun is shrinking, thus raising questions on the stability and energy generated by the Sun.

However powerful our solar companion may be, it also has a life cycle. Presently, the sun is enjoying its middle ages. Old age will come in approximately five billion years, when the sun burns up all its hydrogen fuel. The helium core will contract and grow with intense heat and luminosity to become a red giant star. It will be so big that it will at least encompass the planet Mercury where it is today. Eventually, the Sun will run out of fuel to become a white dwarf of small radius. Finally, it will embrace the arms of death as a "nonluminous object of degenerate matter", a black dwarf.



NASA

The US spacecraft, Ulysses, will encounter the giant planet, Jupiter, and be hurled towards the Sun in order to study polar activity.



NASA

NASA's satillite Solar Max, a spacecraft dedicated to studying solar activity, is constantly gathering data that increases our knowledge of the sun.

EULER UY

Lillimar Avelino, an EE-CS major in her junior year, in addition to her position as co-editor of MECHELECIV, is also very active in other campus organizations. She serves as corresponding secretary for both Eta Kappa Nu, and Tau Beta Pi engineering honor societies. She is currently a co-op student at Acoustics Division in Naval Research Lab.

REFLECTIONS FROM...

ASCE

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

Have you ever heard of the ASCE? ASCE stands for the American Society of Civil Engineers. The ASCE has both national and student chapters throughout the United States. The role of the ASCE is to make engineers (and future engineers) aware of what is happening around them in the field of civil engineering. It also serves as a mechanism to unite civil engineers as a whole. Here at The George Washington University our student chapter is presently building. Our current enrollment is over 50 members.

WHY JOIN ASCE?

A) First of all, if you do not intend to be involved in an engineering related profession, you need not read any further! Our student ASCE chapter is only for highly motivated engineering students who enjoy learning, facing challenges, and reaping the rewards of hard work. You must be honest with yourself, "Do I really want to become an engineer?"

B) Underclassmen probably benefit from ASCE the most. Freshman and sophomore years are the most frustrating. The light at the end of the tunnel (i.e., graduation) cannot be seen yet and the course load seems pointless. Underclassmen many times ask themselves, "Why am I taking all this calculus and physics? What does any of this have to do with engineering? Will I ever be actually using any of this?" The ASCE is an excellent way for upperclassmen to assure underclassmen that their studying is not futile. Specific examples and their importance can be demonstrated where applications of calculus, physics, and other courses apply.

C) All ASCE members benefit from the field trips that the organization sponsors. Field trips are fascinating opportunities to discover how the technical courses, which we all take, are applied in the real world. Examples of some field trips include: Blue Plains Water Treatment Plant, Museum of History and Technology, Metro site visits, etc.

D) Guests speakers are a standard ASCE function. Their importance lies in the fact that guest speakers enlighten students of the practicality of their studies. After the guest has made his speech, refreshments are served and students have an opportunity to talk with him.

E) With the hustle and bustle of exams, projects, deadlines, and work which occur during the academic year, many times it is difficult to meet other classmates. The fact that GW has students with diverse nationalities adds to this as well. ASCE overcomes this problem. Working together on various projects brings students together and develops an Esprit de Corps. Taking time to socialize and relax with other students who share a similar interest is important. It acts as a support group and leads to better study habits.

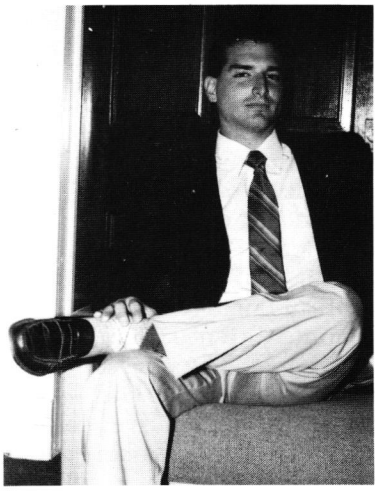
F) The ASCE also offers many scholarships for students in need of financial assistance.

HOW DO YOU JOIN?

To join the ASCE, see Dr. Mahmood's secretary Jimmy Roberts on the 7th floor of the Academic Center (The CMEE department.) Room T-730. Jimmy has the necessary form and will accept your application fee. Application fees are $3.00 for student chapter membership and $5.00 for national chapter membership. The fees should be paid by check made out to : The GW ASCE Student Chapter, and, The ASCE National Chapter, respectively.

In addition, a schedule of events for the academic year will be mailed to all ASCE members. Another source of event information is the ASCE bulletin board next to the conference room in the CMEE Department.

— Steven L. Creighton



EULER UY

Steven L. Creighton, a senior CE major, is a transfer student from Strouburg University in Pennsylvania. He is also a lieutenant in the U.S. Army Corps of engineers and is attached to the 121st Engineer Battalion, a Maryland National Guard unit. After graduation, he plans to gain a Master's Degree in structural engineering. He is also looking forward to the upcoming year, and the events which teh ASCE will be hosting.

ETA KAPPA NU The International Honor Society for Electrical and Computer Engineers

Ever since the establishment of The George Washington University's Theta Iota Chapter of Eta Kappa Nu (HKN) in 1979, each successive group of HKN members have sought means to improve the educational quality and environment of their university. For the 1986-87 academic year, HKN has expanded its semesteral survey/evaluation of instructors from the Electrical Engineering and Computer Science (EE/CS) Department. The revised procedures included the administration of survey forms in person by HKN members and the distribution of survey results to students during pre-registration and registration. Those revisions were made possible by the dedicated efforts of the officers and members of HKN with advice from EE/CS Chairman Roger Lang, Dr. Rachelle Heller, and other EE/CS instructors, plus assistance from the Society of Women Engineers (SWEE).

As usual, induction ceremonies and subsequent banquets were held in both the fall and spring. Fourteen initiates became members of HKN on November 2, 1986. At their banquet, HKN brought together the chairmen of the EE/CS and of the Computer Medicine Departments so that the feasibility of an interdisciplinary curriculum from both SEAS and the School of Medicine may be discussed. Computer Medicine Professor Helmuth Orthner, who was inducted into HKN that evening, presented the guests at the banquet with an overview of medical informatics. At the spring induction ceremony held on April 11, 1987, seventeen initiates were welcomed as new members of HKN. Among the inductees was Dr. Rachelle S. Heller from EE/CS. MECHELECIV introduced Dr. Heller to its readers in Edition 2 of Fall 1986. The HKN inductees for the spring attended The Second Annual Engineering Honors Banquet along with inductees and members from three other engineering honor societies, namely Tau Beta Pi, Pi Tau Sigma, and Omega Rho.

At the brunch prior to the Spring Honors Convocation held on April 12, 1987, Professor Raymond Pickholtz, HKN's faculty advisor, presented the HKN sponsored annual Abd Elfattah Abd Alla Prize for superior academic achievement and outstanding services rendered to fellow engineering students. Mr. Ka P. Lee and Mr. Danial Mdnoor shared the honor of the Abd Alla Prize for this academic year.

On April 29, 1987, Eta Kappa Nu presented the prestigious annual "Teacher of the Year" awards to three deserving recipients from the EE/CS Department. Professor Walter K. Kahn received the "Teacher of the Year" Award for a full-time professor. Professor Larry A. Fletcher accepted the "Teacher of the Year" Award for a part-time professor. Mr. Duncan W. Mills received the "Teacher of the Year" Award for a graduate teaching assistant. In presenting the "Teacher of the Year" awards, the member of HKN on behalf of all EE/CS students conferred upon the recipients their admiration for the dedication they have shown during the past academic year. Furthermore, HKN desired to inform instructors that students do care about how they are being educated and do truly appreciate instructors who spend quality time preparing for lectures and explaining concepts and methods in a coherent and congenial manner.

Congratulations go to the returning and new officers of HKN for academic year 1987-88. Mr. Ka P. Lee, Miss Rose A. Province, and Miss Lilimar Z. Avelino were re-elected as president, vice-president, and corresponding secretary, respectively. The newly-elected officers were Mr. Louis R. (Bob) du Treil, Jr. as treasurer and Miss Laura J. Gruber as recording secretary.

Future plans for HKN included further expansion of its survey/evaluation of EE/CS instructors to include the use of an optical reader. An EE/CS student or instructor interested in becoming an HKN member may contact HKN via its mailbox at the Davis-Hodgkins House, 22nd and G Streets, N.W., Washington, D.C. 20052.

— Ka P. Lee

Ka Lee is entering his senior year as an EE major. Among Ka's ambitions are becoming a communications engineer and leaving his mark on society. Currently, Ka serves as Campus News editor for MECHELECIV, president of Eta Kappa Nu, secretary of GWU's Engineering Council, and treasurer of Tau Beta Pi and Omega Delta Kappa. Ka enjoys the nuances of consciousness.

TAU BETA PI

TAU BETA PI

"The Tau Beta Pi Association was founded at Lehigh University in 1885 by Edward Higginson Williams, Jr. to mark in a fitting manner those who have conferred honor upon their Alma Mater by distinguished scholarship and exemplary character as students in engineering, or by their attainments as alumni in the field of engineering, and to foster a spirit of liberal culture in engineering colleges."
— The Preamble to the constitution of The Tau Beta Pi Association

The DC Gamma chapter of Tau Beta Pi National Honor Society was established at George Washington University on February 16, 1963. When the Sigma Tau Fraternity merged into the Tau Beta Pi Association in 1974, the Xi chapter of Sigma Tau at George Washington University was absorbed into the DC Gamma chapter.

The DC Gamma of Tau Beta Pi is one of the most active student organizations on campus. Many activities and projects were successfully done in the last academic year. Free tutoring service was provided to engineering students in almost all freshman and sophomore courses. According to the Dean of the School of Engineering and Applied Science, significant progress was achieved by those students who participated in the tutoring service. In February 1987, the chapter started its first publication of the Tau Beta Pi "Connection", the monthly engineering newsletter. The chapter would like to thank the Engineering Council for the financial support of the "Connection", which is published only during the regular semesters.

Last semester, one of the most exciting events in SEAS was the First Annual Engineers Olympics. The chapter contributed much manpower as well as ideas. The Engineering Council and the chapter agreed to work together in the future for more successful and exciting Engineers' Annual Olympics.

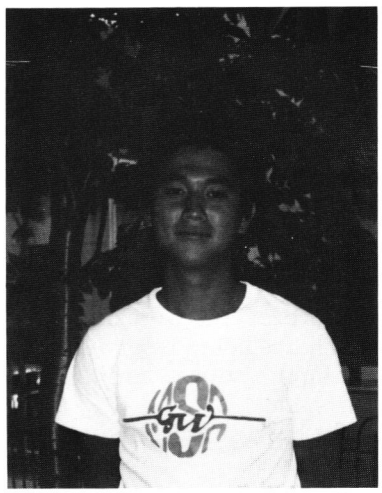
Funding is a major concern for almost all organizations in order to have sufficient money to support their activities. This chapter had a car wash project in April 1987. Over two hundred dollars were collected from the project, with a fraction of these contributions from the public going back to the public. Tau Beta Pi will donate some amount of money to a social welfare organization for charity purposes.

Due to a growing concern about the new grading system, Tau Beta Pi expressed its opinions to the vice president of student affairs. Based on the majority vote among the members, the chapter disagreed on the new grading system that will take effect in Fall 1987 semester. The chapter also advised a postponement of the grading system until the University can further investigate the effects that this grading system change would have on the University.

The year ended with awards and initiations. The Outstanding Sophomore Award for 1985-86 was presented to Miss Laura Gruber in the Annual Honor Convocation. Miss Laura Gruber was one of the top students in her class during her sophomore year, and met all the requirements in order to win this award. Also on April 11, 1987, the chapter initiated fifteen new members. Three of them were graduate students.

One of the heaviest tasks the chapter will have in the future is to come up with a complete Instructors Evaluation Survey for the School of Engineering and Applied Science. In addition to the upcoming evaluation survey and other regular projects of the chapter, the chapter is looking forward to coming up with more activities. Many of these activities will, hopefully, provide the University with more students possessing distinguished scholarship and exemplary character.

— Poh Chuan Chua



Poh Chuan Chua is a senior scholar from Malaysia, majoring in CE. In addition to his scholastic achievements, Poh is involved in other activities. He is president of Tau Beta Pi, the senior representative to the Engineer's Council, and is an active member of the ASCE. Poh worked for 7K Construciton Compony during the summer and will also be participating in the honors research program.

SPORTS, FUN, AND LAUGHTER... AT THE FIRST ANNUAL ENGINEER'S OLYMPICS !!!!

On April 17th 1987, the first annual Engineers' Olympics was held in the Smith Center . . . .a day of good sportsmanship, athletic excellence, and great, clean fun was enjoyed by all who participated and who watched. However, before the fun and games are described, the preparation of the entire event by a so called "JOINT ENGINEERS OLYMPIC COMMITTEE" must first be accredited. Phil Han, a TAU BETA PI member, was the chairman of this committee. Originally, only a group of engineering students got together to have this athletic event, however, financial problems arose. To relieve such misfortunes, the Engineering Council aided in their financial difficulties. Other problems, unfortunately were not so easily resolved; some of which were as follows:

— The Smith Center facilities were not available during Engineers' week.

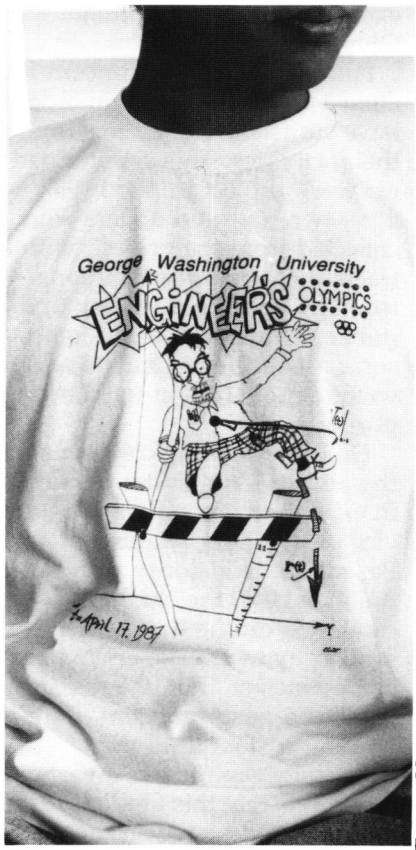
— Sports events were limited, due to facilities being reserved like swimming, squash courts, tennis courts, etc.

— The biggest problem was lack of man power.

— Many participants did not show up on time, so replacements for them had to be attained rapidly for the games to continue on schedule.

Aside from these technicalities, the games resumed successfully, without fighting, unfair conduct, or cheating. With a mere $1.00 fee, the engineering student participated in his choice of events and received a tee-shirt for participation. This $1.00 fee and the tee-shirt were an ingenious tactic for encouraging the students who signed up to appear during the games. The tee-shirt design was creatively mastered by Eric Wolf.

The events held were: Volleyball (most participated in event), Obstacle, 3 on 3 Basketball, Bombardment, Soccer shootout, Free Throw, and Baskets in one minute. The scoring was by points given to each department, corresponding to the place they won in each event;i.e., 5 points for first place, 3 points for second place, and 1 point for third place. According to this scoring procedure, the Electrical Engineers came in a leaping overall first place, the Mechanical Engineers followed close behind to attain second place, the operations research participants received third place, the computer science participants came fourth place and the Civil Engineers ended up in fifth place.



EULER UY

"FANTASTIC T-SHIRT . . . INGENIOUS DESIGN . . . But who made it?" It's a one of a kind ERIC WOLF design, made uniquely for the ENGINEERS' OLYMPICS!

No one was a loser in this year's Engineers' Olympics. Everyone enjoyed a fun filled, competitive, exhausting day, and each person walked out with not only a smile and aching bones, but also a magnificently designed "ERIC WOLF" tee-shirt!!!

In the future, we urge everyone, including faculty, students, and volunteers, to get involved early so that we can reserve all facilities needed ahead of time for more events, more competition, and more fun. Where this year's Engineers' Olympics is concerned, a special thanks goes out from all the engineering students to the TAU BETA PI Honor Society, the Engineering Council, all faculty members and students who participated, and volunteers who assisted. These people should be greatly thanked and accredited for their dedicated effort and hard work in providing the most spirited event in the history of the George Washington University Engineering School.

— Swati R. Patel

STAY TUNED

NEXT ISSUE

BACK TO THE FUTURE WITH TECHNOLOGY

EULER UY

The MECHELECIV staff demonstrates their support of the Engineer's Olympics by wearing the Olympic T-shirt.

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